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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/624,555	07/23/2003	Yukio Taniguchi	240669US2	7498

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OBLON, SPIVAK, MCCLELLAND, MAIER & NEUSTADT, P.C.  
1940 DUKE STREET  
ALEXANDRIA, VA 22314

EXAMINER
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ROSASCO, STEPHEN D

ART UNIT	PAPER NUMBER
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1756

DATE MAILED: 07/26/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

10/624,555

Applicant(s)

TANIGUCHI ET AL.

Examiner

Stephen Rosasco

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 20 June 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-31 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-31 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 23 July 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date 4/29/05.
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

### Detailed Action

In response to the traversal of the restriction requirement the examiner withdraws the requirement and examines all of the claims here.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sato et al. (6,746,942) or Kunii et al. (6,734,635).

The claimed invention is directed to a crystallization apparatus and method, wherein the apparatus includes an illumination system that illuminates a phase shift mask to irradiate a polycrystalline semiconductor film or an amorphous semiconductor film with a light beam that has a light intensity distribution of an inverse peak pattern that has a minimum light intensity in an area corresponding to a phase shift portion of the phase shift mask to produce a crystallized semiconductor film, comprising: an optical member to form on a predetermined plane a light intensity distribution of a concave pattern, which has a light intensity that is minimum at the center and increases toward the circumference based on the light from the illumination system; and an image-forming optical system to set a surface of the polycrystalline semiconductor film or the amorphous semiconductor film or its conjugate plane and the predetermined plane to an optical conjugate relationship.

The applicant discusses the limitations of the prior art in that although polycrystalline silicon comprises a set of crystallized grains, it has a lower mobility of

electrons or electron holes than monocrystalline silicon. Furthermore, in a small transistor formed by using the amorphous silicon, there is a problem of irregularities in crystal grain boundary number at a channel portion. Thus, in recent years, in order to improve the mobility of electrons and electron holes and reduce irregularities in crystal grain boundary number at a channel portion (activation portion) of each TFT, many crystallization methods, which produce crystal grains with a larger particle size have been proposed.

Sato et al. teach (col. 10, line 41 on) an apparatus and a method of fabricating a semiconductor thin film, the method comprising the steps of: forming a non-single crystal thin film on an insulating base; subjecting the non-single crystal thin film to a first heat-treatment, thereby forming a polycrystalline thin film; and subjecting the polycrystalline thin film to a second heat-treatment, thereby forming a crystallized semiconductor thin film; wherein a radius of curvature of each of projections on the surface of the crystallized semiconductor thin film is larger than a radius of curvature of each of projections on the surface of the polycrystalline thin film.

And wherein said polycrystalline thin film has on its surface projections each having a radius of curvature of 60 nm more or less.

And wherein at least either said first heat-treatment and said second heat-treatment is performed by irradiation of laser beams emitted from an excimer laser.

And wherein said irradiation of line beam laser is performed by overlapping the laser beams in a scanning direction perpendicular to a longitudinal direction of the irradiation of line beam laser.

Kunii et al. teach a process of crystallizing a semiconductor thin film previously formed on a substrate by irradiating the semiconductor thin film with a laser beam, comprising: a preparation step of dividing the surface of the substrate into a plurality of division regions, and shaping a laser beam to adjust an irradiation region of the laser beam such that one of the division regions is collectively irradiated with one shot of the laser beam; a crystallization step of irradiating one of the division regions with the laser beam while optically modulating the intensity of the laser beam such that a cyclic light-and-dark pattern is projected on the irradiation region, and irradiating the same division region by at least one time after shifting the pattern such that the light and dark portions of the pattern after shifting are not overlapped to those of the pattern before shifting; and a scanning step of shifting the irradiation region of the laser beam to the next division region, and repeating said crystallization step for the division region.

And wherein said crystallization step comprises a step of controlling the direction of crystallization by making use of a temperature gradient corresponding to the light-and-dark pattern, and irradiating the same division region again after shifting the pattern by a distance within a crystallization distance by one shot of laser irradiation.

And wherein said crystallization step is performed by using a phase shift mask, which diffracts the laser beam to form a cyclic light-and-dark pattern.

The teachings of Sato et al. or Kunii et al. differ from those of the applicant in that the applicant teaches that the mask has a transmittance distribution according to the light intensity distribution having a concave pattern to be formed on the predetermined plane.

However, the teachings of the cited prior art with respect to the transmittance distribution through the mask, wherein Sato et al. teach a radius of curvature of each of

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projections on the surface of the crystallized semiconductor thin film is larger than a radius of curvature of each of projections on the surface of the polycrystalline thin film, and wherein Kunii et al. teach that light and dark portions of the pattern after shifting are not overlapped to those of the pattern before shifting, are such that they could be adjusted in order to produce a concave pattern for exposure.

It would have been obvious to one having ordinary skill in the art to take the teachings of Sato et al. or Kunii et al. and adjust arrangement of shifters on the mask to give a concave resulting pattern in order to make the claimed invention because the modification of mask features such as phase shifters placement is well known and would be obvious to adjust to give the desired result.

### *Conclusion*

Any inquiry concerning this communication or earlier communications from the Examiner should be directed to Stephen Rosasco whose telephone number is (571) 272-1389. The Examiner can normally be reached Monday-Friday, from 8:00 AM to 4:30 PM. The Examiner's supervisor, Mark Huff, can be reached on (571) 272-1385. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



S. Rosasco  
Primary Examiner  
Art Unit 1756

S. Rosasco  
07/21/05